

Arsenic and Drinking Water

November 2001

The levels of arsenic in your drinking water could affect your health. The levels of concern are lower than previously thought and, as a result, the EPA is lowering its drinking water standard for arsenic. Levels above the new standard have been found in groundwater at various locations in Iowa. This fact sheet has been prepared by the Iowa Department of Natural Resources and the Iowa Department of Public Health to provide you with facts on arsenic and what you can do to determine if your well water has arsenic in it.

What is arsenic?

Arsenic is a naturally occurring, common element found in the earth's crust. Very low levels of arsenic are also present in plants and foods such as fish as well as in the air. Arsenic is typically found in combination with other elements – arsenic compounds – and has no distinctive taste or smell. Many of these compounds occur naturally but some are man-made.

Arsenic compounds have had number of uses including medicines, manufacturing, pesticides and even livestock feed additives, but most of these uses have been discontinued. Today, the main use is for a wood preservative, chromated copper arsenate or CCA, although small amounts are still used for pesticides, as a metal alloy, and for electronic components. Since 1985, arsenic used in the U.S has been imported.

Why the concern over arsenic if it occurs in nature?

At very low levels, there is relatively little concern. The body may even need very small amounts of arsenic. However, new evidence shows the amount of arsenic that can cause health problems is lower than previously thought. Most people consume small amounts of arsenic in the food they eat, but drinking water with even low to moderate levels of arsenic can provide more than is safe. And the most toxic form of arsenic, known as inorganic arsenic, is the form typically found in groundwater. Studies have shown that people drinking well water with elevated levels of arsenic have higher risks of some diseases.

Drinking well water with low to moderately elevated levels of arsenic over a long period of time may lead to *chronic* health effects. Chronic health effects, such as cancer, develop over a number of years and can be difficult to detect, especially in the early stages. Higher levels of arsenic can also lead to more immediate or *acute* health effects that usually have more noticeable symptoms.

The amount of arsenic in water is measured in *micrograms* of arsenic per liter of water, abbreviated as µg/L, or as *milligrams* per liter, abbreviated as mg/L.*

* To obtain the level in mg/L, multiply the level in µg/L by 1,000. One µg/L is equivalent to one part per billion (ppb), one mg/L is equivalent to one part per million (ppm) by weight. A concentration of 1.0 µg/L is roughly equivalent to one ounce of pure arsenic in 7½ million gallons of water

What are the levels of concern and the associated health effects?

Most people know that arsenic has been used as a poison but it is very unlikely the levels in groundwater will cause immediate death. However, the levels that might be present in some groundwater could cause short term or acute health problems that have one or more of the following symptoms:

- Nausea, vomiting, diarrhea, and abdominal pain
- Fatigue, abnormal heart rhythm
- Abnormal bruising
- “Pins and needles” sensations in your hands and feet

These acute symptoms would not normally be expected unless an adult person drinks water with arsenic levels exceeding 500 µg/L - the actual level causing acute symptoms could vary depending on a number of factors including body weight and water consumption. Levels above 500 µg/L are not expected in Iowa groundwater and, for that reason, the long term or chronic effects of arsenic are a greater health concern in Iowa.

Chronic health effects include an increased risk of cancer and other life-threatening diseases. The strongest evidence shows a link between arsenic and skin, bladder, and lung cancer, with bladder and lung cancer being the biggest concern. Some studies suggest arsenic may also increase the risk of prostate, kidney, and liver and other cancers, but the data is not conclusive.

Other studies indicate that arsenic may have non-cancer effects including:

- Cardiovascular disease such as high blood pressure, heart disease, and stroke;
- Diabetes
- Reproductive problems
- Immune and nervous system problems,

The lowest level of arsenic in water that can have long term or chronic health effects is not known. The Environmental Protection Agency's current standard for drinking water, known as a Maximum Contaminant Level or MCL, is 50 µg/L but is now being lowered to 10 µg/L. MCL's are based on a number of factors including economics and reflect what is considered an acceptable, not zero, risk of health effects. Some feel the MCL should be set at 3 or 5 µg/L, not 10 µg/L. If there is a threshold value below which there is no known risk, it is believed to be much lower than the range of values that were considered for the new MCL.

Not all experts agree on the health effects, the relative risks, or the levels of arsenic that cause health problems. Other environmental contaminants as well as lifestyles (for instance, smoking) can also cause these health problems and may have greater risks than drinking water with low to moderate levels of arsenic. The risk can vary from person to person due to a number of factors including the amount of water consumed and body weight. Like most health studies, not all arsenic studies arrived at the same conclusions but one of the strengths of the studies is that actual human health effects were considered, not animal studies with high doses.

When looking at current data, most experts seem to agree that long term consumption of water with levels greater than 3 µg/L will lead to an increased risk of skin, lung and bladder cancer. The risk increases with the level of arsenic. The National Academy of Science's best estimate is that, over a lifetime, drinking water with an arsenic level of 3 µg/L will cause an additional 4 to 10 cases of bladder or lung cancer per 10,000 people. As the level of arsenic increases from 3 µg/L to 10 µg/L, the risk more than doubles and from 10 µg/L to 20 µg/L the risk again doubles.

As with many things, risk needs to be put in perspective to make rational decisions. For instance, the National Academy estimates that over a lifetime an additional 45 out of every 10,000 males in the U.S. would get bladder cancer as a result of drinking water with 20 µg/L over an extended period. But this would account for only 1/8 of the total risk of male bladder cancer. The proportional risk is even smaller for lung cancer when considering the incidence of lung cancer from all causes. Drinking water with arsenic in it will, in fact, increase the risk of life threatening diseases, but arsenic at low to moderate levels is only a part of the total risk of lung and bladder cancer. Some people may feel that low to moderate levels of arsenic in their drinking water is a minor concern compared to other risks and elect to not do anything about it. On the other hand, it makes sense to reduce that risk by removing the arsenic from your drinking water, especially if it can be done at a reasonable cost.

How does the arsenic get in drinking water?

Although hazardous waste sites, spills and other sources of man-made arsenic compounds have contaminated groundwater in a few areas, the main cause is the natural weathering and decomposition of soil and minerals. Water coming in contact with this material can dissolve the arsenic. In some areas, this natural process results in levels of dissolved arsenic in groundwater that can have human health effects if used as a source of drinking water.

Are high levels of arsenic found in Iowa groundwater and, if so, where?

Arsenic levels above 10 µg/L have been detected in groundwater at a number of locations in Iowa. Most of the levels were less than 50 µg/L, although some have approached or exceeded 200 µg/L. Levels lower than 10 µg/L are likely more common, but the analytical methods typically used in the past did not measure levels that low.

There is not enough data to be able to predict with any accuracy where and in what aquifers or geologic formations there might be problems. Monitoring data for public water supplies show the north central portion of Iowa seems to have a higher probability of levels over 10 µg/L, but this does not mean other areas will not have arsenic above the levels of concern. Even within an area of assumed low levels, there may be "hot spots" with high levels.

Is there a way to know if I've been exposed to arsenic?

Most people will have some level of arsenic in their body due to the background levels of arsenic in food, air and water. The question is whether you have been exposed to levels that might cause health problems. Analysis of hair, fingernail,

and urine samples can be used to determine past exposure but these tests are not very helpful in detecting lower level exposures that could cause chronic health effects. If you exhibit some of the health effects described above, arsenic could be a factor, but keep in mind that these problems can be caused by many other things. Other symptoms can include a darkening of the skin or the or small corns or warts on your palms, soles or torso. Again, these symptoms by themselves do not prove exposure to arsenic. You should contact your doctor or health care provider if you believe you have any of these symptoms.

Our recommendation is to check your drinking water for arsenic. The level of arsenic in your water today is a good indication of what you have been consuming over a longer period of time, as the level of arsenic in groundwater doesn't appear to change quickly.

If you have your own well, or get water from a shared well that is not part of a public water supply system, have the well water tested. Your county health department may be able to provide advice on getting your well tested and the county may be able to pay for part of the cost. Testing for arsenic is not particularly expensive but it is important that proper procedures be followed when collecting the sample. Also make sure the sample is analyzed by a laboratory certified by the Department of Natural Resources for drinking water analysis and find out the lowest levels of arsenic the test can detect and measure. The test should be able to detect levels down to 1 µg/L.

If you obtain your water from a public water supply system, such as a municipality, check with the system operator. Public water supply systems are regulated by the Department of Natural Resources and are required to periodically test for arsenic, so the public water supply operator should know the latest test results. Some public water supplies using groundwater will be required to test for arsenic more frequently in the future. Under federal and state laws, public water supply systems will have to meet the new 10 µg/L standard by 2006.

Once I get the test results, then what?

For private wells, there are no state, federal, or local regulations that will require you to do anything if the results show you have arsenic levels above the new MCL of 10 µg/L. So you will have to use your own judgement. Because not all experts agree on the health effects of arsenic, the levels of arsenic that cause problems, or the relative risk compared to all the other things in your life, it can be confusing.

Based on a review of the current information, we suggest the following:

- Arsenic levels above 200 µg/L. This level is clearly cause for concern and we strongly suggest obtaining your drinking water from another source that is known not to have high levels. Alternatively, a home treatment device can be installed.
- Arsenic levels from 10 µg/L to 200 µg/L. Levels in this range will increase the risk of long term or chronic health problems. The higher the level, the greater the risk. Don't panic – remember, chronic conditions develop over a long period of time. Make plans to obtain water from another source or install a

home treatment system, especially if you plan on staying in the area for very long.

- Arsenic levels from 3 µg/L to 10 µg/L. Even though the new arsenic MCL is being established at 10 µg/L, some health experts feel it should be lower. If you have levels in this range, you may want to obtain water from another source or install a home treatment system, especially for small children, pregnant women, or mothers that are nursing. Data suggests that arsenic may affect small children differently than adults. Arsenic is found in mothers' milk and will cross the placenta to a fetus, both of which may affect development of a child.

Is there a problem with using water with arsenic for other purposes such as showering?

At levels below 50 µg/L, there should be no problem in using the water for showering or bathing or washing clothes. Washing dishes or using the water for cooking where the water is not consumed (for instance, cooking vegetables) should not pose a significant risk.

Can I treat the water to remove the arsenic?

There are home treatment systems that will remove arsenic. Reverse osmosis (RO) units will remove arsenic and are fairly common but, as with any treatment device, require regular maintenance to be effective. You should check with the manufacturer or the Iowa Department of Public Health to make sure the unit you are considering will remove arsenic to a level below 10 µg/L.

An alternative might be another well drilled to a deeper depth. If other, deeper wells in your immediate area have low no detectable levels of arsenic, a deeper well may be a solution, but there is no certainty a new, deeper well will yield lower levels of arsenic. Another alternative is to hook up to a public water system such as a rural or municipal water system that does not have detectable levels of arsenic in their water.

For public water supplies serving a large number of people, there are a number treatment techniques that can be used and the Environmental Protection Agency is investigating other techniques that may be more economical, especially for the smaller public water supplies.

Where can I find out more information?

If you want more information on the issue of arsenic and health effects, there are a number of sources. We suggest you read a variety of articles before making conclusions, rather than relying on only one source. The EPA's web site (<http://www.epa.gov/safewater/arsenic.html>) has information as well as links to other sources such as the National Academy of Sciences' report. A number of technical and trade magazines have had articles on arsenic over the past several years and you may want to search your library's database for references.

Feel free to contact the following people with your questions:

- For information on public water supply systems and their testing requirements as well as test results – Joe Zerfas, Iowa Department of Natural Resources, Des Moines, 515-725-0343.
- For information about health effects of arsenic in drinking water - Karen Buechler, Iowa Department of Public Health, Des Moines, 515-281-6596.
- For information on residential treatment units certified for arsenic removal – Bruce Middleton, Iowa Department of Public Health, Des Moines, 515-281-4680.
- For information on certified laboratories – Charlotte Lafarge-Henderson, Iowa Department of Natural Resources, 515-725-0341.

Listed below are the laboratories certified by the Iowa Department of Natural Resources (as of November 2001) to test for arsenic in drinking water and that have indicated they will analyze samples for homeowners for a fee. Certification status can change and you should always check to make sure the lab's certification is current. Other labs may be added to the list in the future.

Name	Address	Phone
Environmental Health Laboratories	110 South Hill Street South Bend, IN 46617	219-233-4777
Keystone Laboratories - Newton	600 East 17th Street South Newton, IA 50208	641-792-8451
Midwest Laboratories, Inc.	13611 B Street Omaha, NE 68144-3693	402-334-7770
MVTL - Nevada	35 West Lincoln Way PO Box 440 Nevada, IA 50201	515-382-5486
Nebraska Analytical Testing Laboratories, Inc	4123 South 67th Street Omaha, NE 68117	402-331-0935
Severn Trent Laboratories Chicago	2417 Bond Street University Park, IL 60466-3182	708-534-5200
TestAmerica Cedar Falls Division	704 Enterprise Drive Cedar Falls, IA 50613	319-277-2401
University Hygienic Laboratory	102 Oakdale Campus University of Iowa Iowa City, IA 52242	319- 335-4500
Water Quality Association	4151 Naperville Road Lisle, IL 60532	630-505-0160